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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/710,828	08/05/2004	Daniel C. Edelstein	FIS920040159	4827

30743 7590 03/13/2007
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EXAMINER

PIZARRO CRESPO, MARCOS D

ART UNIT	PAPER NUMBER
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2814

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/13/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/710,828	Applicant(s) EDELSTEIN ET AL.	
	Examiner Marcos D. Pizarro-Crespo	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 and 21-23 is/are pending in the application.
 4a) Of the above claim(s) 10 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 22 is/are allowed.
- 6) ☒ Claim(s) 1-9, 21 and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

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Attorney's Docket Number: FIS920040159US1 (00750492AA)

Filing Date: 8/5/2004

Claimed Foreign Priority Date: none

Applicant(s): Edelstein et al.

Examiner: Marcos D. Pizarro-Crespo

DETAILED ACTION

This Office action responds to the amendment filed on 1/18/2007.

Acknowledgment

1. The amendment filed on 1/18/2007, responding to the Office action mailed on 6/29/2006, has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-10 and 21-23.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-9, 21, and 23 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

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4. Regarding claim 1, the limitations in lines 8-11 are not supported by the disclosure as originally filed. Although the original disclosure generally describes that the alloying material forms a graded composition distribution (see, e.g., par.0018), a *continuously* graded concentration of alloying material from a reaction front where a stoichiometric alloy has been formed is not described in the specification as originally filed.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter that the applicant regards as his invention.

6. Claims 1-9, 21, and 23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. In line 10, claim 1 recites the limitation "stoichiometric alloy". Stoichiometry is the quantitative relationship between reactants and products in a chemical reaction. An alloy, on the other hand, is a homogeneous mixture or solid solution between two or more metallic materials. The term "stoichiometric" defines a chemical reaction, whereas the term "alloy" is a mixture or solution that does not involve a chemical reaction. The term "stoichiometric alloy" in claim 1 renders the claim indefinite because it is not defined by the claim, the specification does not provide a standard for ascertaining what is meant by the term, and one of ordinary skill in the art would not be reasonably appraised of the scope of the invention.

8. Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine

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the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term “stoichiometric alloy” in claim 1 is used by the claim to describe an alloy. The term, however, is indefinite because the specification does not clearly set forth the meaning of the term. The skilled artisan would not be reasonably appraised of the differences between an alloy, as is generally known in the art, and the claimed “stoichiometric alloy”.

9. In lines 15-17, claim 1 recites that the alloying material reacts with the metal or metal alloy of the first or second layers. As set forth in paragraphs 7 and 8 above, an alloy is a mixture or solid solution between metallic materials and does not involve a chemical reaction. These limitations in claim 1, therefore, render the claim indefinite because one of ordinary skill in the art would not be reasonably appraised of the scope of the invention since alloys are known in the art as mixtures and not as compounds formed by chemical reactions, as it is recited in the claim.

10. Claim 23 recites the limitation “said annulus”. There is insufficient antecedent basis for this limitation in the claim.

Claims Rejection

11. Initially, and with respect to claim 1, note that a “product by process” claim is directed to the product *per se*, no matter how actually made. See *In re Thorpe*, 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product *per se* which must be determined in a “product by process”

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claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe,

even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935).

12. Note that **the applicants have the burden of proof** in such cases, as the above case law makes clear.

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

15. Claims 1-4, 6, and 7, are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser (US 6633085) in view of Lopatin (US 6368961).

16. Regarding claim 1, Besser (see, e.g., fig. 7) shows most aspects of the instant invention including an integrated circuit including:

- A first layer **30** having metal or metal alloy at a surface thereof
- A second layer **34** adjacent to said surface and having a metal or metal alloy via **52** therein
- An interlayer connection between the metal or metal alloy of the first layer **30** and the via **52**

wherein the interlayer connection comprises a stable alloy region **50** restricted by a barrier layer **46** to an interfacial region between the metal or metal alloy of the first layer **30** and the via **52**. Besser, however, fails to show the stable alloy region **50** having graded mechanical characteristics. Lopatin (see, e.g., abstract/II.6-10), on the other hand, teaches that providing said graded mechanical characteristics to Besser's alloy region would simultaneously provide the alloy region with good adhesion to both the barrier layer **46** and the copper line **30**. Lopatin also teaches that the concentration of alloying material is continuously graded from a front **225** where the alloy connection **224** has been formed (see, e.g., fig. 2).

It would have been obvious at the time of the invention to one of ordinary skill in the art to provide Besser's alloy region with Lopatin's graded mechanical characteristics

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to provide the alloy region with simultaneous good adhesion properties to both the barrier and the copper line.

17. Regarding claim 1, it is noted that the method of forming the interlayer connection by fully reacting the metal or metal alloy with the alloying material, is an intermediate method step that does not affect the structure of the final device.

4. Regarding claim 2, Besser shows the metal or metal alloy of the first layer is a first metal **30** and the metal or metal alloy of the second layer is a second metal **52** (see, e.g., fig. 7).

18. Regarding claim 3, Besser shows the metal or metal alloy comprises copper (see, e.g., col.4/ll.51).

19. Regarding claim 4, Besser shows the barrier includes a layer of tantalum nitride (see, e.g., col.5/ll.54).

20. Regarding claim 6, Besser shows the metal alloy of the interlayer connection at said interface includes tin (see, e.g., col.5/ll.17).

21. Regarding claim 7, Besser shows the barrier **46** is above the interlayer connection and the metal alloy of the interlayer connection **50** is confined to a region below the barrier **46** (see, e.g., fig. 7).

22. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Besser in view of Lopatin and Wang (US 6884329).

23. Regarding claim 5, Besser shows most aspects of the instant invention (see, e.g., paragraph 16 above). Besser also shows that the barrier may be tantalum or tantalum nitride (see, e.g., col.5/ll.54). He, however, fails to show the barrier including

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both a layer of tantalum and a layer of tantalum nitride. Wang (see, e.g., col.5/ll.46-50), however, teaches that using both, tantalum would act as an adhesion layer and tantalum nitride as a barrier layer.

It would have been obvious at the time of the invention to one of ordinary skill in the art to have Besser's barrier comprising a layer of tantalum and a layer of tantalum nitride, as suggested by Wang, to have a copper diffusion barrier layer functioning as both an adhesion and a barrier layer.

Allowable Subject Matter

24. Claim 22 is allowed

25. Claims 8 and 9 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 1st and 2nd paragraphs, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Response to Arguments

26. The applicants argue:

There is no indication in Lopatin that the relative proportions of copper and tin (or other alloying metals; magnesium and aluminum being disclosed) is varied between layers or that the resulting composite layer **224** has graded mechanical characteristics.

27. The examiner responds:

Lopatin shows the above features of the claimed invention. See, e.g., abstract/ll.6-10, where Lopatin teaches that providing said graded mechanical characteristics to Besser's alloy region would simultaneously provide the alloy region with good adhesion to both the barrier layer **46** and the copper line **30**. That is, the high

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nitrogen content at the bottom of the layer favors adhesion of the alloy layer to the barrier layer, whereas the lack of nitrogen at the top surface of the layer favor adhesion to the copper layer. See, e.g., Lopatin: col.3/ll.1-9.

Conclusion

28. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(571) 272-1716** and between the hours of 9:30 AM to 8:00 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Marcos.Pizarro@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (571) 272-1705.

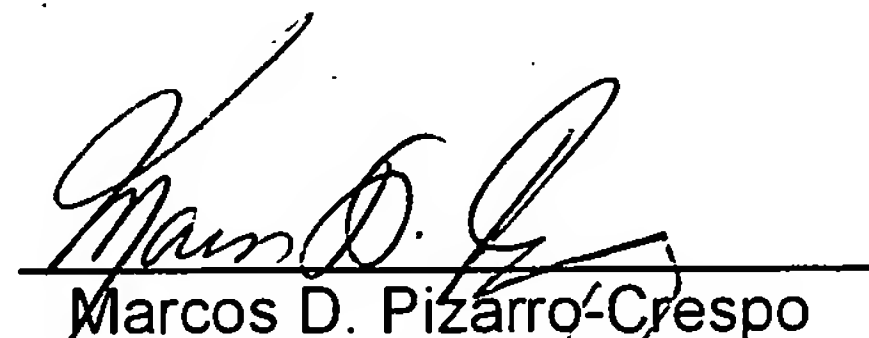
30. Any inquiry of a general nature or relating to the status of this application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair->

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direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

31. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 257/750-766	3/2/2007
Other Documentation:	
Electronic Database(s): EAST (USPAT, EPO, JPO)	3/2/2007


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MDP/mdp
March 2, 2007